Department of Sustainability and Environment

Surveys and management guidelines for dunnarts in Cathedral Range State Park and the Big River Catchment

Black Saturday Victoria 2009 – Natural values fire recovery program

Jenny Nelson, Micaela Jemison

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Surveys and management guidelines for dunnarts in Cathedral Range State Park and the Big River Catchment

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This project is No. 30 of the program 'Rebuilding Together' funded by the Victorian and Commonwealth governments' Statewide Bushfire Recovery Plan, launched October 2009.

Published by the Victorian Government Department of Sustainability and Environemnt, February 2012

Authorised by the Victorian Government,
8 Nicholson St, East Melbourne.

Print managed by Finsbury Green
Printed on recycled paper

ISBN 978-1-74287-430-2 (print)
ISBN 978-1-74287-431-9 (online)

For more information contact the DSE Customer Service Centre 136 186.

Citation: Nelson, J. L. and Jemison, M. L. (2012). Surveys and management guidelines for dunnarts in Cathedral Range State Park and the Big River Catchment: Black Saturday Victoria 2009 – Natural values fire recovery program. Department of Sustainability and Environment, Heidelberg, Victoria.

Front cover photo: Dunnart detected by remote camera, Big River Catchment, North East Victoria.

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Acknowledgements

This project is No. 30 of the program 'Rebuilding Together' funded by the Victorian and Commonwealth governments' Statewide Bushfire Recovery Plan, launched October 2009.

We would like to thank Stephen Smith (Natural Values Fire Recovery Coordinator, Department of Sustainability and Environment (DSE)) for facilitating this project. Nick Clemann (DSE, Arthur Rylah Institute for Environmental Research) managed the project and provided comments on an earlier draft of this report.

This project was conducted in partnership with Parks Victoria (PV). Thanks to Julie Flack (Ranger in Charge, Lake Eildon National Park) and Neil Mackinnon (Ranger, Lake Eildon National Park) for logistic support and for coordinating community participation. Neil Mackinnon assisted with all aspects of the field work in Cathedral Range State Park. Rhyl Shaw, Sam Strong, Tara Sanders (all PV, Alexandra) and Mark Mickelburough (PV, Woori Yallock) also assisted with some field work in Cathedral Range State Park.

We would particularly like to thank members of the Friends of Cathedral Range State Park community group: Moira Jeffreys, Bill Jeffreys, Ann Jelinek, Lea Jellinek and Cathy Olive (Department of Primary Industries, Alexandra), and volunteers, Emma Houston and Sam Mackinnon, for their assistance with this survey.

Summary

In May 2010, remote camera surveys were conducted in Cathedral Range State Park by the 'Friends of Cathedral Range State Park' community group and school children from St Mary's Primary School, Alexandra. These surveys were part of project 12 of the program 'Rebuilding Together' funded by the Victorian and Commonwealth governments' Statewide Bushfire Recovery Plan, launched October 2009.

The surveys captured images of a dunnart, either the White-footed Dunnart *Sminthopsis leucopus* or Common Dunnart *S. murina.* This is the first record of a dunnart for the Park, and for either species represents an extension of their known range. In response to this discovery, this project was added to the program to further investigate dunnart occurrence in Cathedral Range State Park and other public land in the area.

White-footed Dunnarts and Common Dunnarts are difficult to identify in the field, and can only be distinguished by close examination of the underside of the hind feet. To determine which species of dunnart was present in the Park, an aim of this project was to resurvey the site where the dunnart was initially detected, using Elliott traps. Community members who helped set the cameras in the initial survey were invited to participate in this follow-up survey. To investigate the status and distribution of dunnarts more broadly, and the impact of the 2009 bushfires on dunnarts, additional sites were surveyed using remote cameras in burnt and unburnt habitat in the Park and in the Big River Catchment, focusing on areas where dunnarts have been recorded in the past.

Four sites were surveyed with Elliott traps close to where the dunnart was detected in the earlier survey of Cathedral Range State Park. Ten other sites were also surveyed, each with two remote cameras set opposite bait stations, elsewhere in the Park. Camera trapping was also conducted at seven sites in Lake Eildon National Park and nine sites in adjoining State Forest south of the Park. Three of these sites were close to where White-footed Dunnarts were last recorded in this area in 1989. To facilitate an assessment of the impact of the 2009 bushfires on dunnarts and other mammals, fire severity was assessed at each camera site.

No dunnarts were captured in Elliott traps (400 Elliott trap nights) or detected by camera trapping (471 camera trap nights) in Cathedral Range State Park during this survey. Therefore, the species of dunnart, detected previously by remote camera, cannot be determined at this stage. 'Friends' of the Park assisted with all aspects of the Elliott trapping program, during which three species of small mammals were captured. This provided a valuable opportunity for members to have a 'hands-on' experience of small mammals occurring in the Park after the fire. Ten species of native mammals were detected by camera trapping in Cathedral Range State Park, including a new species for the Park, the Eastern Pygmy Possum *Cercartetus nanus*. Nine species of native mammals were detected in Lake Eildon National Park and adjoining State Forest. In both areas, similar numbers of species were detected in unburnt or lightly burnt sites as severely or moderately burnt sites. These results highlight the ability of native mammals to persist in fire-affected areas and the resilience of these populations to broad-scale bushfires.

Dunnarts were camera trapped at four sites in State Forest in the Big River Catchment; two of these sites were in close proximity to records of White-footed Dunnart obtained in 1989. Although White-footed Dunnarts and Common Dunnarts cannot be distinguished from images obtained by camera trapping, based on earlier records of White-footed Dunnart from the area, and the habitat present at sites where dunnarts were camera trapped during this survey, it is most likely the species detected was the White-footed Dunnart. The four sites where dunnarts were camera trapped were classified as lightly scorched and contained unburnt patches of vegetation. Whether dunnarts were present at the time of the fire and survived the immediate impacts, or recolonised these sites from unburnt areas nearby, is unknown.

Records of dunnarts obtained during these surveys have highlighted the ability of dunnarts to persist in fire-affected areas. Further surveys in more severely burnt areas, and ongoing monitoring of the dunnart population and the characteristics of occupied habitat, would provide additional information for assessing the impact of broad-scale bushfires. This would also facilitate the development of land management recommendations for dunnarts in this area, including the intensity and frequency of planned burns.

1 Background

In May 2010, the 'Friends of Cathedral Range State Park' community group, together with school children from St Mary's Primary School, Alexandra, undertook a wildlife survey within Cathedral Range State Park using infrared-triggered remote cameras. The park was extensively burnt on Black Saturday in February 2009 by the Kilmore East-Murrindindi Complex North bushfire and the aim of this community survey was to investigate mammals occurring in the Park after the fire. During the survey an image of a dunnart, either a White-footed Dunnart (*Sminthopsis leucopus*) or Common Dunnart (*S. murina*), was captured. This is the first record of dunnart for the Park and, for either species, represents an extension of their known range (Data Source: 'VBA_Fauna25', August 2010 © The State of Victoria, Department of Sustainability and Environment). The White-footed Dunnart is listed as threatened in Victoria under the *Flora and Fauna Guarantee Act 1988*, while the Common Dunnart is classified as vulnerable in Victoria (DSE 2007).

Dunnarts are small, nocturnal, insectivorous marsupials similar in size to a House Mouse. In Victoria, White-footed Dunnarts have been recorded from a wide range of habitats including coastal tussock grassland and sedgeland, wet heath, and heathy woodland and forest (Menkhorst 1995, Lunney 2008). In contrast, Common Dunnarts occur in drier and more open habitats, occupying dry forest and woodland, mallee scrub and dry heath (Morton *et al*. 1980). The ranges of the two species are mostly complementary; White-footed Dunnarts occur across southern Victoria, while Common Dunnarts are found mainly in the north and west of the State (Figure 1). However, the ranges of the two species overlap north-east of Melbourne and in the far south-west of the State in the Dartmoor area. Where their ranges overlap, Common Dunnarts appear to occupy drier sites where the shrub and ground vegetation is sparse (Morton *et al*. 1980, Menkhorst 1995).

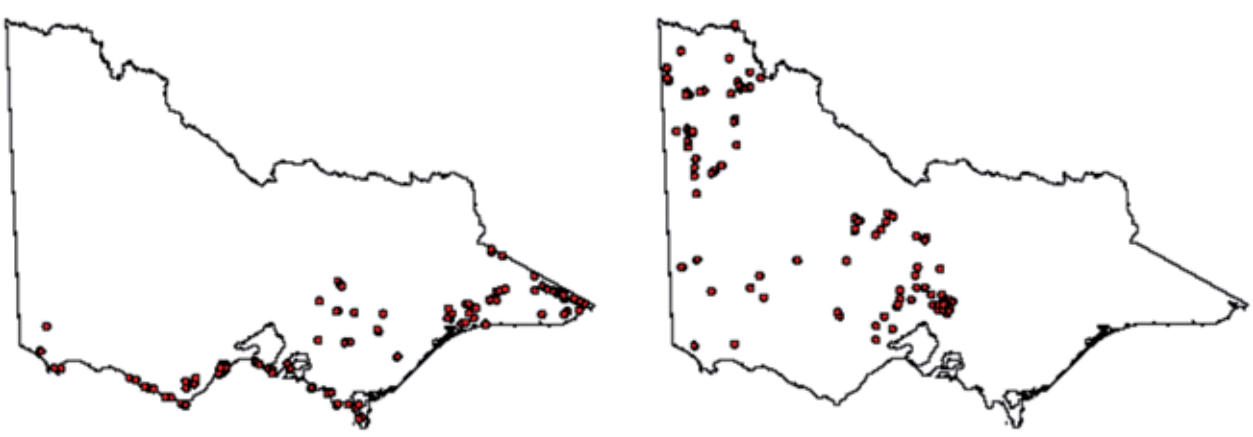
White-footed Dunnarts and Common Dunnarts are difficult to identify in the field and can only be distinguished by close examination of the underside of the hind feet (Morton *et al*. 1980, Menkhorst and Knight 2004). In order to determine which species of dunnart was present in Cathedral Range State Park, an aim of this project was to re-survey the site where the dunnart was initially detected, using Elliott traps. This would allow any captured dunnarts to be examined and definitively identified. Community members who helped set the cameras in the initial survey were invited to participate in this follow-up survey, providing an opportunity for hands-on experience of small mammals occurring in the Park after the fire. To investigate the distribution of dunnarts more broadly within the Park, additional sites were also surveyed using remote cameras.

The closest records of dunnarts to Cathedral Range State Park are of White-footed Dunnart, which were last recorded in Lake Eildon National Park and nearby State Forest in 1989, approximately 20 km to the north-east (Data Source: 'VBA_Fauna25', August 2010 © The State of Victoria, Department of Sustainability and Environment). Most of Lake Eildon National Park was not burnt in the 2009 bushfire. However, State Forest south of the Park was extensively burnt, including two locations where dunnarts were recorded in 1989. To determine the current status of dunnarts in this area, remote camera surveys were conducted in burnt and unburnt habitat, focusing on areas where dunnarts have been recorded in the past.

Determining the current status of dunnarts in areas burnt in the 2009 bushfire, as well as unburnt areas nearby, will increase understanding of the impacts of fire and facilitate the development of land management recommendations for the species.

Figure 1. Distribution of the White-footed Dunnart (left) and Common Dunnart in Victoria (right).

(Data Source: 'Atlas of Victorian Wildlife', © The State of Victoria, Department of Sustainability and Environment (accessed via the 'Victorian Fauna Database', 2007– © Viridans Biological Databases).



2 Methods

2.1 Study areas

All maps in the sections below were produced using Biodiversity Interactive Map © The State of Victoria, Department of Sustainability and Environment, Download Date: May 2011. See Figures 2 and 3.

2.1.1 Cathedral Range State Park

Cathedral Range State Park (approximately 3,600 ha) encompasses the Cathedral Range and Little River Valley and lies east of the Maroondah Highway between the townships of Buxton (37° 25′ S, 145° 42′ E) and Taggerty (37° 19′ S, 145° 42′ E) (Figure 2). The landform of the Park is dominated by the 7 km long and 1.5 km wide ridge of the Cathedral Range, with the highest peak, Sugarloaf Peak, rising to 923 m at the southern end of the range (Parks Victoria 1998).

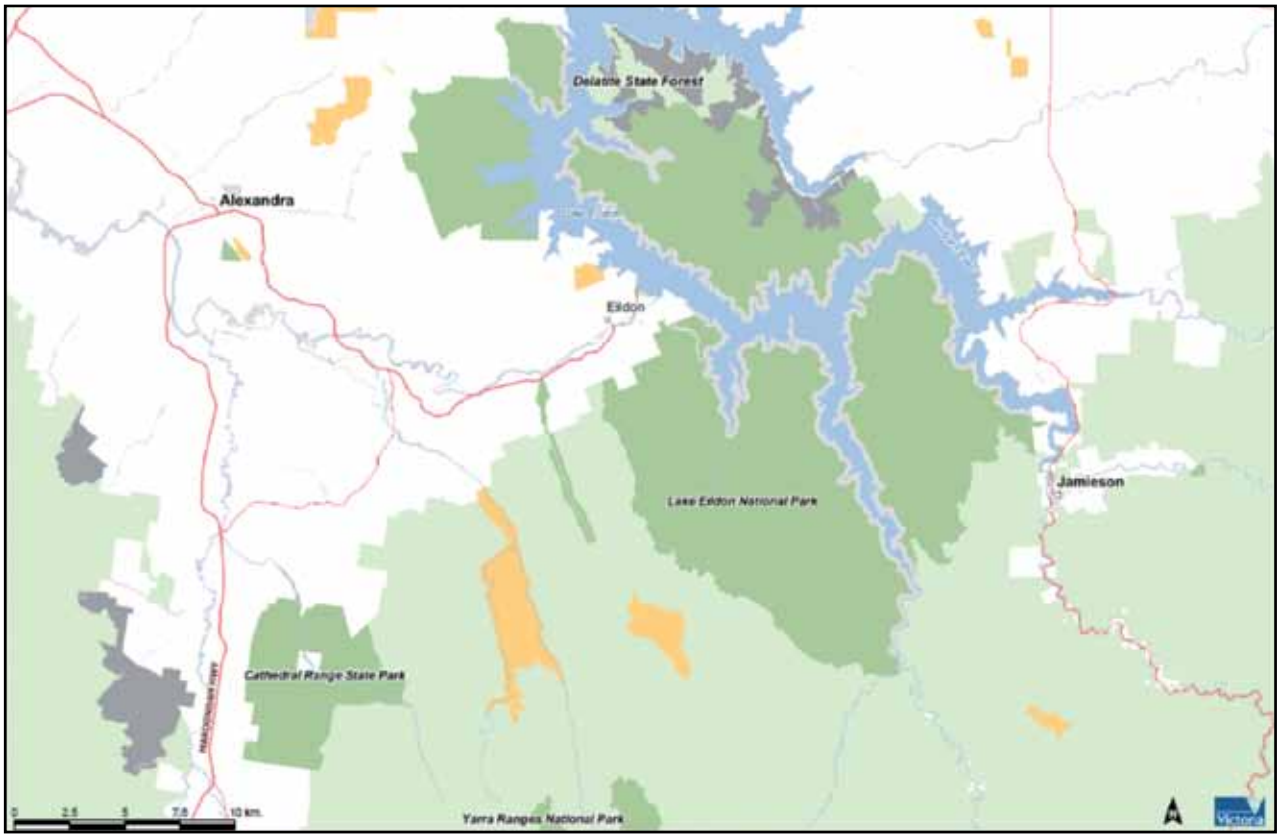
A wide range of vegetation communities occur in the Park. The Ecological Vegetation Classes (EVCs) covering the greatest area include: Herb-rich Foothill Forest, Grassy Dry Forest and Damp Forest. Riparian Forest is also common, occurring along permanent streams flowing through the Park (Data source: 'NV_EVCBCS', August 2010 © The State of Victoria, Department of Sustainability and Environment).

Approximately 90% of Cathedral Range State Park was burnt in February 2009 by the Kilmore East-Murrindindi Complex North bushfire (Figure 3, Data Source: 'LASTBURNT100', August 2010 © The State of Victoria, Department of Sustainability and Environment).

2.1.2 Lake Eildon National Park and adjoining State Forest

Lake Eildon National Park (27,750 ha) is in the northern foothills of the Victorian Central Highlands, close to the township of Eildon (37° 10′ S, 145° 56′ E) (Figure 2). The Park is characterised by strongly dissected mountainous terrain and contains rugged hills with open woodlands through to dense forest (Parks Victoria 1997). The vegetation of the Park is mostly comprised of dry forest EVCs including: Herb-rich Foothill Forest, Shrubby Dry Forest and Grassy Dry Forest. Damp Forest and Riparian Forest are also present, occurring mostly along streams (Data source: 'NV_EVCBCS', August 2010 © The State of Victoria, Department of Sustainability and Environment). Herb-rich Foothill Forest, Shrubby Dry Forest and Damp Forest are the most common EVCs in the State Forest adjoining the Park to the south (Data source: 'NV_EVCBCS', August 2010 © The State of Victoria, Department of Sustainability and Environment).

Figure 2. Cathedral Range State Park, Lake Eildon National Park and adjoining State Forest. Parks are indicated by dark green shading and State Forest by light green shading.



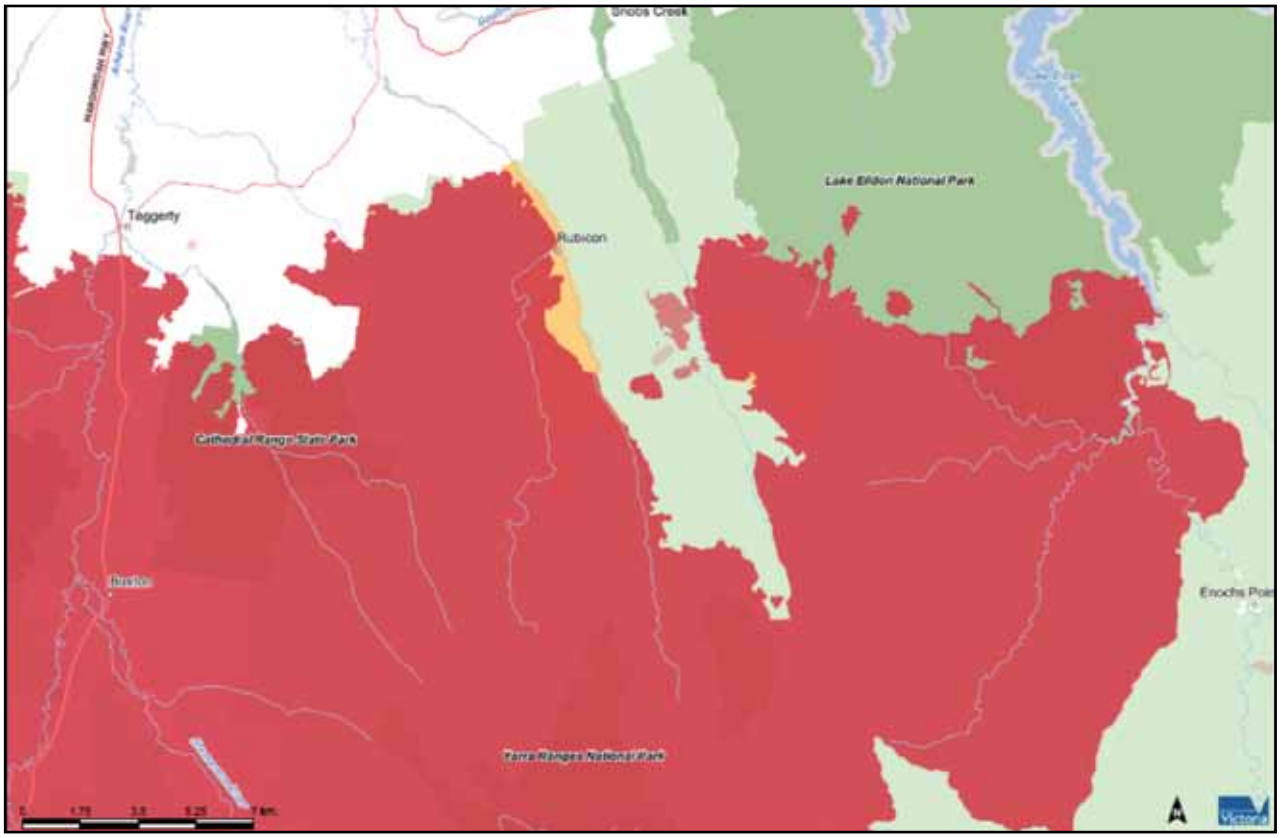
Lake Eildon National Park remained largely unburnt in 2009, with the fire mostly contained a short distance inside the Park's southern boundary. However, large areas of State Forest directly south of the Park were burnt by the Kilmore East-Murrindindi Complex North bushfire (Figure 3, Data Source: 'LASTBURNT100', August 2010 © The State of Victoria, Department of Sustainability and Environment).

2.2 Elliott trapping

To determine which species of dunnart is present in Cathedral Range State Park, four sites were surveyed in the vicinity of where the dunnart was recorded in the May 2010 survey. Elliott type A traps (Elliott Scientific Equipment, Upwey, Victoria, Figure 4) were used. At each site 25 traps in a 5 x 5 metre grid were deployed with five traps along each line separated by 10 m, and the lines by 25 m. The traps were baited with standard mammal bait of peanut butter, rolled oats and golden syrup, and set for four consecutive nights from 3–7 November 2010. To provide trapped animals with some protection from the elements, traps were covered with plastic bags and contained insulating mats of high density foam (Clark Rubber ©) and nesting material (Dacron®). Traps were checked each morning and captured animals identified, sexed and a small patch of fur trimmed from the rump to allow identification of re-captures, and then released at the point of capture.

Figure 4. Elliott trap set at Cathedral Range State Park, November 2010.

Figure 3. Part of the extent of the Kilmore – Murrindindi Complex North, 2009 Black Saturday bushfire including study areas at Cathedral Range State Park and Eildon National Park.



2.3 Camera trapping

To investigate the distribution of dunnarts more broadly, two camera traps were installed at each of 10 sites within the Cathedral Range State Park (Figure 5), at 15 sites within the Jerusalem Block of Lake Eildon National Park in the south-west corner of the Park, and in State Forest adjoining this block in the Big River Catchment (Figure 6). The Jerusalem Block was chosen for survey as the three historic records of White-footed Dunnarts for the area fall within this block or in adjoining State Forest to the south (Data Source: 'VBA_Fauna25', August 2010 © The State of Victoria, Department of Sustainability and Environment). Camera traps were left on site for 3–4 weeks, between 4 November and 2 December 2010 in Cathedral Range State Park, and 13 January and 8 February 2011 in Lake Eildon National Park and adjoining State Forest.

Camera traps consisted of an infrared-triggered digital trail camera activated by heat and motion sensors (Pixcontroller DigitalEyeTM 7.2, Pixcontroller Inc, Pennsylvania, USA), set opposite a bait station which acted as an attractant to draw animals into the detection field of the camera's sensor (Figure 7). Each camera unit was mounted on a tree trunk 2 m from the bait station, with the sensor approximately 25 cm above the ground. Setting the camera close to the ground helped prevent small animals failing to trigger the camera by passing underneath the sensor's zone of detection. A distance of 2 m between the bait station and the camera ensured that any animal photographed investigating the bait was clearly illuminated by the camera's internal white-light flash. Baits consisted of standard mammal bait (peanut butter, rolled oats and golden syrup), placed in four stainless steel tea infusers. The tea infusers were then placed inside a wire mesh cage and fixed to a pole so that the bottom of the bait cage was approximately 20 cm above the ground. Vegetation that might obscure the camera's view of an animal investigating the bait was cleared from the site. Camera units were set on maximum sensitivity with a 10 second gap between successive images. As dunnarts are nocturnal, camera units were set to only operate at night. Photographs were saved to 1GB xD memory cards and the time and date set on the camera so that this information was accurately recorded with each photograph.

Animals captured on digital images were identified with reference to appropriate field guides and, if needed, by consultation with other experienced researchers.

Figure 5. Camera trap locations (blue squares) at 10 sites (2 cameras per site) in the Cathedral Range State Park, November 2010.

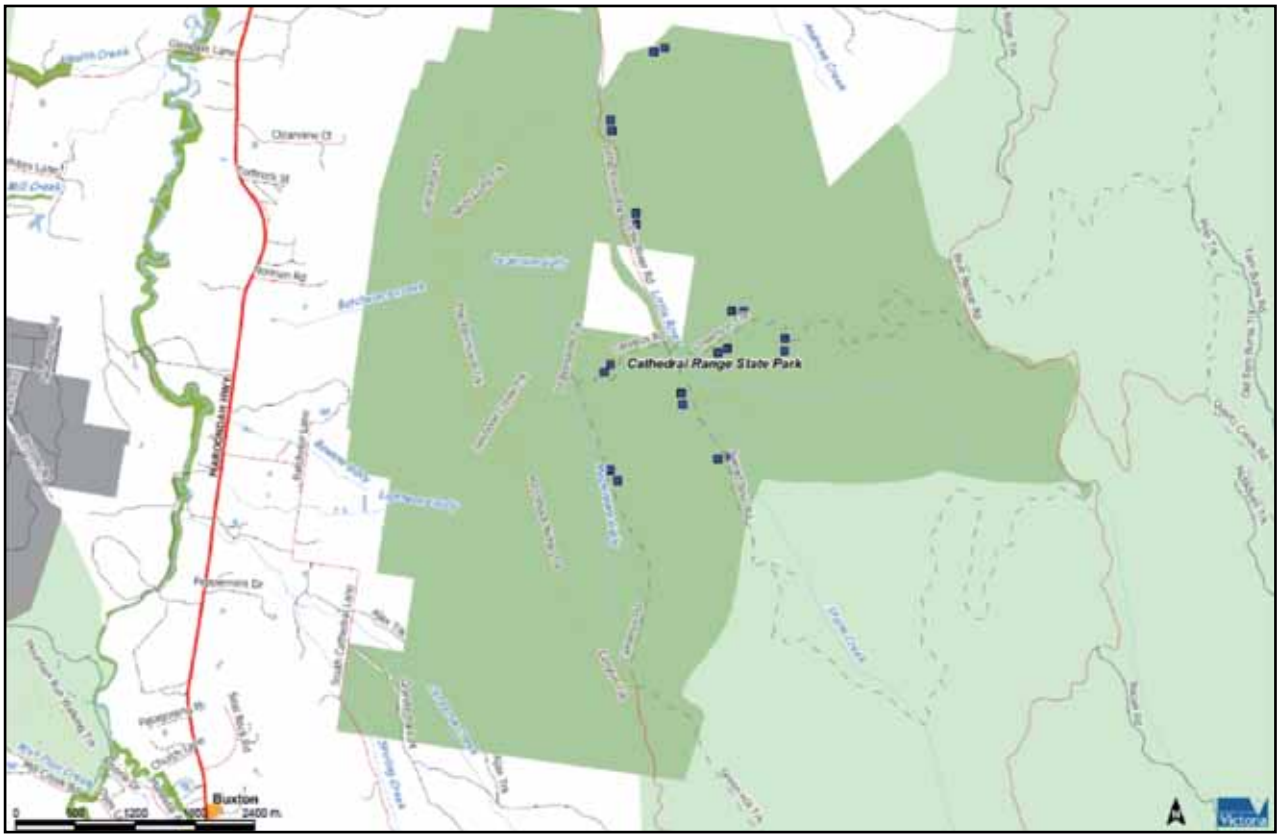


Figure 6. Camera trap locations (blue squares) at 15 sites (2 cameras per site) within the Jerusalem Block of Lake Eildon National Park and adjoining State Forest (light green), January 2011. Red stars indicate historic White-footed Dunnart records.

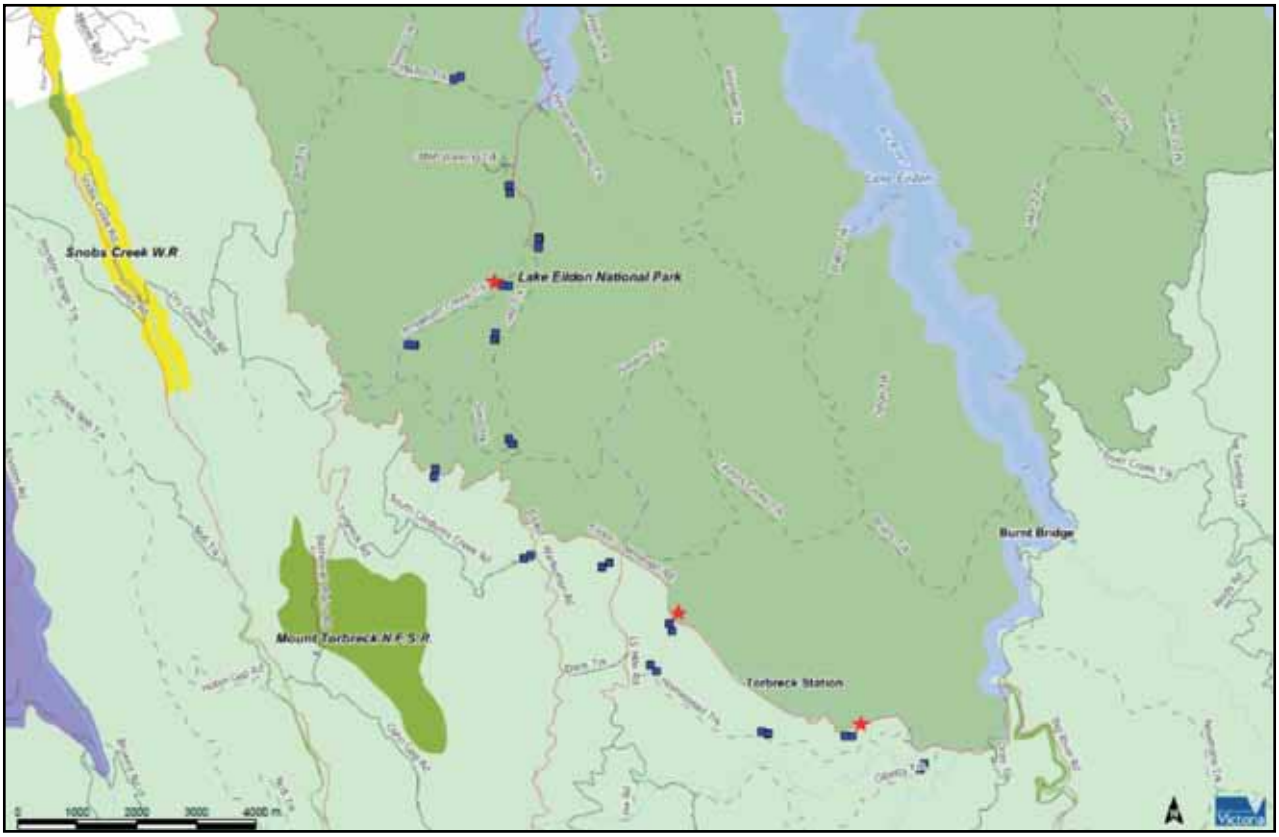


Figure 7. PixController trail camera (to the right of picture) set opposite a bait station (to the left of picture), Cathedral Range State Park, November 2010 (Jenny Nelson).

2.3.1 Fire severity

To facilitate an assessment of the potential impact of the 2009 fire on dunnarts, sites were surveyed in areas that ranged from completely burnt to unburnt. Fire severity was assessed at each camera site using DSEs Spot 5 Satellite Image Fire Severity Classification (DSE 2007b), with fire severity classes assigned based on the criteria outlined in Table 1.

Table 1. Fire severity classes assigned to dunnart survey sites, Cathedral Range State Park, and Lake Eildon National Park and adjoining State Forest.

Severity class	Severity type	Spot description
1	Burnt	*100% of vegetation is burnt* An intense fire with complete vegetation burn
2	Severe scorch	*60–100% of vegetation is scorched, some vegetation is burnt* An intense understorey fire with widespread vegetation scorch
3	Moderate scorch	*30–65% of vegetation is scorched* A variable intensity of fire ranging from a light ground burn with minimal vegetation scorch to an intense understorey fire with widespread vegetation scorch
4	Light scorch	*0–35% of vegetation is scorched* A light ground burn with isolated patches of intense understorey fire and unburnt areas
5	Unburnt	Not burnt

3 Results

3.1 Cathedral Range State Park

3.1.1 Elliott trapping

Three species of small mammals were captured in Elliott traps over the four nights of the survey (Table 2). The overall survey effort was 400 Elliott trap nights. The most commonly captured species was the Bush Rat (*Rattus fuscipes*), with 14 captures at two sites. A single Agile Antechinus (*Antechinus agilis*) and House Mouse (*Mus musculus*) were each captured at one site. No dunnarts were captured.

3.1.2 Community involvement

Members of the community group 'Friends of the Cathedral Range State Park' and Parks Victoria staff assisted with all aspects of the trapping, including initial set up, daily checking, identifying and releasing captured animals, and removing traps at the completion of the survey.

3.1.3 Camera trapping

With the exception of one camera that failed on the day it was set, cameras remained operable at the ten survey sites within Cathedral Range State Park for 18–27 nights, with a total survey effort of 471 camera trap nights. No dunnarts were detected during the survey. Overall, 14 species of mammals were detected, including four introduced species (Table 3). Black Wallaby (*Wallabia bicolor*) (Figure 9) and Common Wombat (*Vombatus ursinus*) were the most commonly detected species and were recorded at ten and nine sites respectively. Four species of small mammals including Bush Rat, Eastern Pygmy Possum (*Cercatetus nanus*) (Figure 10), Agile Antechinus (Figure 11) and House Mouse were detected, although at only one or two sites.

Figure 8. Park 'Friends' Bill and Ann checking an Elliott trap, Cathedral Range State Park.

Table 2. Species captured in Elliott traps at four sites in Cathedral Range State Park, 3–7 November, 2010. Eastings and Northings are the trap coordinates at the centre of the 5 x 5 grid of traps. Brackets contain the numbers of captures of each species.

Site	Location	Easting	Northing	Species
1	Friends Nature Trail	390867	5863196	House Mouse (1)
2	Friends Nature Trail	391167	5861969	Bush Rat (8)
3	Lowerson Track	390812	5862467	Agile Antechinus (1) Bush Rat (6)
4	Lowerson Track	391297	5862467	Nil

Table 3. Species detected by camera trapping at 10 sites in Cathedral Range State Park, November 2010.

Species		No. of sites	% of sites
Black Wallaby	*Wallabia bicolor*	10	100
Common Wombat	*Vombatus ursinus*	9	90
Mountain Brushtail Possum	*Trichosurus cunninghami*	7	70
Common Brushtail Possum	*Trichosurus vulpecula*	4	40
European Rabbit	*Oryctolagus cuniculus*	4	40
Eastern Grey Kangaroo	*Macropus giganteus*	3	30
Short-beaked Echidna	*Tachyglossus aculeatus*	3	30
Bush Rat	*Rattus fuscipes*	2	20
Eastern Pygmy Possum	*Cercartetus nanus*	2	20
House Cat	*Felis catus*	2	20
House Mouse	*Mus musculus*	2	20
Agile Antechinus	*Antechinus agilis*	1	10
Koala	*Phascolarctos cinereus*	1	10
Red Fox	*Vulpes vulpes*	1	10

Figure 9. Black Wallaby detected by camera trapping in Cathedral Range State Park, November 2010.

Figure 10. Eastern Pygmy Possum detected by camera trapping, Cathedral Range State Park, November 2010.

Figure 11. Agile Antechinus detected by camera trapping, Cathedral Range State Park, November 2010.

3.1.4 Fire severity

The burn severity score for the 10 camera trap sites varied from unburnt to burnt (Table 4). There appeared to be no relationship between the number of species of mammals recorded and how severely sites were burnt in the 2009 fires, with similar numbers of species detected at sites that were the most severely burnt as those that were unburnt or only lightly scorched.

Table 4. Burn severity scores and the number of mammals recorded by camera trapping at 10 sites in Cathedral Range State Park, November 2010. Burn severity classes are described in Table 1.

Site	Location	Burn severity class	No. of species
1	Cerebus Road	Burnt	4
2	Tweed Spur Road	Burnt	5
3	Tweed Spur Road	Burnt	4
4	Cerebus Road	Burnt	8
5	Lowerson Track	Severe scorch	6
6	Lowerson Track	Unburnt	6
7	Little River Road	Unburnt	5
8	Little River Road	Moderate scorch	4
9	Little River Road	Moderate scorch	4
10	Lowerson Track	Light scorch	5

3.2 Lake Eildon National Park and adjoining State Forest

3.2.1 Camera trapping

Camera traps were installed at seven sites in Lake Eildon National Park, and at eight sites south of the park in State Forest in the Big River Catchment. Three sites corresponded to sites where White-footed Dunnarts were recorded in 1989 (Data Source: 'VBA_Fauna25', August 2010 © The State of Victoria, Department of Sustainability and Environment). Cameras remained operable for 9–25 nights, with a total survey effort of 630 camera trap nights. Dunnarts were detected at four sites during the survey (e.g. Figure 12). Two of these sites were on the edge of the Park where White-footed Dunnarts were recorded in 1989. The other two sites where dunnarts were recorded during this survey were within 1.5 km of these sites.

Twelve species of mammals were detected, including three introduced species (Table 5). Black Wallaby and Common Brushtail Possum (*Trichosurus vulpecula*) (Figure 13) were the most commonly detected species, recorded at ten and seven sites respectively. Two species of small mammals (other than dunnarts) were recorded, Bush Rat (Figure 14) and Agile Antechinus, although each at only one site.

Table 5. Species detected by camera trapping at 15 sites in Lake Eildon National Park and adjoining State Forest, January 2011.

Species		No. of sites	% of sites
Black Wallaby	*Wallabia bicolor*	10	67
Common Brushtail Possum	*Trichosurus vulpecula*	7	47
Common Wombat	*Vombatus ursinus*	6	40
European Rabbit	*Oryctolagus cuniculus*	6	40
Mountain Brushtail Possum	*Trichosurus cunninghami*	5	33
Dunnart	*Sminthopsis sp.*	4	27
House Cat	*Felis catus*	2	13
Agile Antechinus	*Antechinus agilis*	1	7
Bush Rat	*Rattus fuscipes*	1	7
Eastern Grey Kangaroo	*Macropus giganteus*	1	7
Short-beaked Echidna	*Tachyglossus aculeatus*	1	7
Red Fox	*Vulpes vulpes*	1	7

Figure 12. Dunnart detected by camera trapping, Big River Catchment, January 2011.

Figure 13. Common Brushtail Possum detected by camera trapping, Big River Catchment, January 2011.

Figure 14. Bush Rat detected by camera trapping, Lake Eildon National Park, January 2011.

3.2.2 Fire severity

The burn severity score for the 15 camera trap sites varied from unburnt to burnt, although the majority of sites were either unburnt or lightly scorched (Table 6). There appeared to be no relationship between the number of species of mammals recorded and how severely sites were burnt in the 2009 fires, with similar numbers of species detected at sites that were severely scorched as those that were unburnt, or only lightly scorched.

The four sites where dunnarts were detected (8, 10, 11 and 13) were all classified as being lightly scorched (Figures 15 and 16).

Table 6. Burn severity scores and the number of mammals recorded by camera trapping at 15 sites in Lake Eildon National Park and adjoining State Forest, January 2011. Burn severity classes are described in Table 1.

Site	Location	Burn severity class	No. of species
1	Jerusalem Creek Track	Unburnt	4
2	Jerusalem Creek Track	Unburnt	3
3	Jerusalem Creek Road	Unburnt	1
4	Gap Track	Unburnt	3
5	Gap Track	Light scorch	3
6	Eildon-Jamieson Road	Severe scorch	4
7	Gap Track	Unburnt	4
8	Homestead Track	Light scorch	1
9	Running Creek Track	Moderate scorch	0
10	Eildon-Jamieson Road	Light scorch	5
11	Eildon-Jamieson Road	Light scorch	4
12	Gilletts Track	Light scorch	2
13	Homestead Track	Light scorch	4
14	South Corduroy Creek Road	Moderate scorch	3
15	Mallets Track	Light scorch	3

Figure 15. Lightly scorched site where a dunnart was camera trapped, Homestead Track, Big River Catchment, January 2011.

Figure 16. Lightly scorched site where a dunnart was camera trapped, Eildon-Jamieson Road, Big River Catchment, January 2011. This site is close to where White-footed Dunnart was recorded in 1989.

4 Discussion

4.1 Cathedral Range State Park

No dunnarts were captured in Elliott traps, or detected by camera trapping in Cathedral Range State Park during this survey, despite the record obtained during the earlier survey conducted by the 'Friends' of the Park and St. Mary's Primary School children. However, it is important to note that failing to detect a species during a survey does not necessarily mean that the species does not occur in the survey area.

Although Elliott trapping has been used successfully to capture dunnarts throughout their range (Lunney *et al*. 1987, Monamy and Fox 2005), pitfall trapping is considered a more effective method of survey for these species (Bennett *et al*. 1989, Menkhorst 1995, Fox 2008). However, in forest habitats, pitfall traps are difficult and labour intensive to install and this method was beyond the scope of this survey. Another potentially effective tool for surveying dunnarts, which is less labour intensive, is providing artificial cover such as concrete pavers or roofing tiles. Fat-tailed Dunnarts (*S. crassicaudata*) were commonly recorded sheltering under tiles deployed to survey reptiles in south-western Victoria (G. Peterson, DSE Statewide Services, pers. comm.). Common Dunnarts have also been recorded beneath concrete pavers deployed to monitor dunnart activity before and after a planned burn in the Warrandyte-Kinglake Nature Conservation Reserve (R. Francis, Abzeco – Applied Botany, Zoology and Ecological Consulting, pers. comm.). These results suggest that the technique of using concrete pavers or roofing tiles is a viable alternative to pitfall trapping. It also allows dunnarts to be captured and examined for species identification and would be suitable for use in future surveys in Cathedral Range State Park.

Overall, 10 species of native mammals were detected by camera trapping in the park. This is despite half the sites being classified in the two most severe burn classes. A range of burn intensity scores were recorded across the 10 survey sites, including sites that were either unburnt or only lightly scorched. This result highlights that, although 90% of the Park was burnt, the fire did not burn with equal intensity.

Although many animals perish during severe bushfire, usually some members of all species persist and most populations multiply quickly in the years after (Catling 1991). An earlier survey of the Park conducted in 1996 (Smith *et al*. 1996) using a range of mammal survey techniques, including trapping and pitfall trapping, recorded nine species of native terrestrial mammals. Only two species, Dusky Antechinus (*A. swainsonii*) and Long-nosed Bandicoot (*Perameles nasuta*), which were detected in 1996, were not detected during the current survey. One species of small mammal not detected by Smith *et al*. (1996), the Eastern Pygmy Possum, was detected at two sites during the current survey. Although there are a few other records of this species within 5 km of the Park's boundaries, and a single record from State Forest on Blue Range Road near the eastern edge of the park (Data Source: 'VBA_Fauna25', August 2010 © The State of Victoria, Department of Sustainability and Environment), this is the first record of Eastern Pygmy Possum in the Park.

4.1.1 Community involvement

Members of the community group 'Friends of Cathedral Range State Park' were involved in all aspects of the dunnart trapping program conducted in the Park. Although no dunnarts were captured in the Elliott traps, three species of small mammals were captured. This provided an opportunity for hands-on experience of small mammals occurring in the Park, and engendered an understanding of the ability of small mammals to recover from bushfires. Information on the recovery of mammals in the Park will also be provided to the community through the provision of images obtained during camera trapping to Parks Victoria, which will be used in visitor education, newsletters (e.g., Regrowth April 2010 issue), and other media releases relating to the post-fire recovery of mammals.

4.2 Lake Eildon National Park and adjoining State Forest

Dunnarts were detected at four sites in State Forest in the Big River Catchment adjoining the south-western edge of Lake Eildon National Park. Two of these sites were in close proximity to records of White-footed Dunnart obtained in 1989 (Data Source: 'VBA_Fauna25', August 2010 © The State of Victoria, Department of Sustainability and Environment). Ecological Vegetation Classes in which dunnarts were recorded during this survey are classified as Damp Forest (2 records), Shrubby Dry Forest (1 record) and Grassy Dry Forest (1 record) (Data Source: 'NV_EVCBCS', August 2010 © The State of Victoria, Department of Sustainability and Environment). Vegetation at the sites was characterised by a very sparse cover of tall shrubs, and a variable, patchy cover of vegetation below 1 m, ranging from sparse to dense (e.g., Figures 15, 16).

The White-footed Dunnart and Common Dunnart are similar in appearance and cannot be distinguished from images obtained by camera trapping (Menkhorst and Knight 2004). However, because the ranges of these two species are mostly complementary, they can often be distinguished by their ranges; White-footed Dunnarts occur in southern Victoria, while Common Dunnarts occur mainly in the State's north and west. Habitats occupied by Common Dunnarts are generally drier and more open than those occupied by White-footed Dunnarts (Morton *et al*. 1980, Menkhorst 1995). The closest record of Common Dunnart to sites where dunnarts were recorded during this survey is approximately 60 km to the south-west at Steels Creek on the edge of Kinglake National Park (Data Source: 'VBA_Fauna25', August 2010 © The State of Victoria, Department of Sustainability and Environment). Based on earlier records of White-footed Dunnart from the area, and the type of habitat at sites where dunnarts were camera trapped during this survey, it is most likely the species detected was the White-footed Dunnart.

4.2.1 Fire severity

The four sites where dunnarts were camera trapped during this survey were all burnt in the 2009 fire. However, all were near the edge of the fire and were classified as only lightly scorched. Fires can impact small mammal populations either directly, by killing animals in their path, or indirectly, by removing their habitat or the vegetation in which they forage, shelter or nest. The loss of vegetation cover and other refuges in which to shelter, such as logs, also exposes small mammals to predation (Catling 1991, Friend 1993, Irvin *et al*. 2003). Ground-dwelling invertebrates are an important component of the diet of White-footed Dunnarts (Lunney *et al*. 1986, Menkhorst 1995). The loss of litter during fires, including dead leaves, bark and twigs, which provides habitat for many invertebrates, is likely to reduce the availability of food for small mammals such as dunnarts, at least in the short-term (Friend 1993, Irvin *et al*. 2003). Despite this, White-footed Dunnarts are thought to benefit from periodic burning of their habitat and are considered to be a species of early to mid-successional stages after disturbances such as fire (Wilson and Aberton 2006, Lunney 2008).

The impact of the 1983 Ash Wednesday bushfires on White-footed Dunnarts has been studied at sites near Anglesea in the Eastern Otways (Wilson and Aberton 2006). In the Otway study area, dunnarts recolonised sites burnt in the 1983 fire after an absence of three years and were recorded on these sites until 18 years post-fire. The species was also recorded at other study sites 10–13 years after wildfire, although no pre-fire or early post-fire data were available from these sites. The authors concluded White-footed Dunnarts recolonise burnt areas relatively quickly and maintain populations in mid-successional years (Wilson and Aberton 2006). In contrast, in New South Wales, White-footed Dunnarts are considered an early-successional species, preferring open, highly disturbed areas, disappearing from study sites three years after logging and fire (Lunney and Ashby 1987, Lunney *et al*. 1987).

In the current study, White-footed Dunnarts were recorded two years after the relevant sites were burnt in the 2009 bushfire. Whether dunnarts were present at the time of the fire and survived the immediate impacts, or whether they recolonised these sites from other areas, is unknown. The ability of small mammal populations to recover from fire has been related to the survival rate of individuals in burnt areas, the presence of unburnt refuges and the rate of vegetation recovery (Irvin *et al*. 2003). White-footed Dunnarts have been recorded sheltering in hollows, underground burrows, beneath strips of bark or small rotting logs, and in patches of dense heath (Laidlaw *et al*. 1996, Lunney *et al*. 1989). As the sites where dunnarts were recorded in this study were only lightly scorched and contained unburnt patches of vegetation, it is possible that any animals present were able to find shelter and survived the immediate impacts of the fire. It is also possible that dunnarts recolonised these sites from unburnt habitat nearby.

Further surveys are warranted to determine whether dunnarts recolonise nearby areas that were more severely burnt. Ongoing monitoring of the dunnart population, together with the characteristics of the habitat they occupy, would provide additional information for assessing the impact of broad-scale bushfires. This would also facilitate the development of land management recommendations for dunnarts in this area, including the intensity and frequency of planned burns.

As found by other studies, such as Wilson and Aberton (2006), the records of dunnarts obtained in this survey have provided additional evidence of their ability to persist in areas burnt by bushfires. Eight other species of native mammals were also detected during this survey and, as found in Cathedral Range State Park, similar numbers were recorded on unburnt sites as on sites that were classified as severely or moderately burnt. These results highlight the resilience of native mammal populations to broad-scale, high intensity bushfires like the Black Saturday fires in February 2009.

4.3 Key findings and recommendations

1. Despite an earlier record of dunnart from Cathedral Range State Park, no dunnarts were captured during this survey. As a result, the species of dunnart that occurs in the Park, either White-footed Dunnart or Common Dunnart, could not be determined.
2. Deployment of grids of concrete pavers or roof tiles may provide an effective method of surveying dunnarts and a viable alternative to Elliott and pitfall trapping for determining which species occurs in Cathedral Range State Park. These 'artificial cover object' techniques also have the advantage of not needing to be constantly monitored because animals are free to come and go from the artificial shelter. It is recommended that this technique is trialled in future surveys for dunnarts in the Park.
3. Involving local community members in mammal surveys in fire-affected areas provides these people with an opportunity for first-hand experience of mammals occurring in these areas. This helps promote understanding of the ability of wildlife to recover from the impacts of bushfires.
4. Camera trapping detected 10 species of native mammals in Cathedral Range State Park, including a new species for the Park, the Eastern Pygmy Possum. Nine species of native mammals were detected in Lake Eildon National Park and adjoining State Forest. In both areas, similar numbers of species were detected in unburnt or lightly burnt sites as in severely or moderately burnt sites. These results highlight the ability of native mammals to persist in fire-affected areas and the resilience of these populations to broad-scale bushfires.

5. Dunnarts were camera trapped at four of 15 survey sites in State Forest in the Big River Catchment. Two of these sites were close to the locations of historic records of White-footed Dunnarts collected in 1989. Dunnarts were not recorded at a third historic site surveyed within Lake Eildon National Park.
6. The four sites where dunnarts were camera trapped were classified as lightly scorched and contained unburnt patches of vegetation. Whether dunnarts were present at the time of the fire and survived the immediate impacts, or recolonised these sites from unburnt areas nearby, is unknown.
7. Records of dunnarts obtained during these surveys have highlighted the ability of dunnarts to persist in fire-affected areas. Further surveys in more severely burnt areas, and ongoing monitoring of the dunnart population and the characteristics of occupied habitat, would provide additional information for assessing the impact of broad-scale bushfires. This would also facilitate the development of land management recommendations for dunnarts in this area, including the intensity and frequency of planned burns.

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